

U.S. Patent Application No. 09/945,340
Amendment dated August 6, 2007
Reply to Office Action dated February 8, 2007

REMARKS

Reconsideration and continued examination of the above-identified application are respectfully requested.

Claims 5, 11-76, 78, 79, 80, 81 and 82 are pending. Claims 11-15 have been withdrawn in view of an earlier restriction requirement.

In the present Amendment, claim 5 has been amended to correct minor typographic matters. New claims 80, 81 and 82 have been added. New claim 80 recites that the carbonaceous material has attached *by chemical modification* at least one organic group. Full support for this amendment can be found throughout the present application, including page 6, lines 23-24, page 9, lines 30-31, page 10, lines 26-29, and page 12, line 8 *et seq.*, of the present application. New claim 81 recites that the carbonaceous material has attached *via chemical modification* at least one organic group *covalently bonded* to the carbonaceous material, and this amendment has the same support as that identified for new claim 80 and specifically page 6, lines 23-24, and elsewhere in the present application. New claim 82 recites that the organic group has an aromatic group *directly attached* to said carbonaceous material, and this amendment has the same support as that identified for new claim 81 and specifically page 8, lines 2-4, and elsewhere in the present application. Accordingly, no questions of new matter should arise and entry of this Amendment is respectfully requested.

Interview Summary

The applicants thank the Examiner of record for the courtesy of the personal interview conducted with one of their representatives, Ramon R. Hoch, on this application on March 6,

U.S. Patent Application No. 09/945,340
Amendment dated August 6, 2007
Reply to Office Action dated February 8, 2007

2007. Responsive to the requirement made in the Examiner's Interview Summary dated March 9, 2007, the substance of the interview is included with this written reply to the last office action. At the interview, the applicants' representative discussed how the "substrates" of the present invention, such as recited in claim 5, are about 1-500 micron size carbon particles to which discrete organic groups are directly attached, while Stalling describes an opposite scenario where a polymeric resin or siliceous matrix serves as the substrate to smaller 7-9 Ångstrom size fullerenes. The applicants' representative referred the Examiner to FIG. 10B of Stalling and requested clarification on where an aromatic portion of the resin support is attached directly to the fullerene according to the Examiner's position of record. In reply to this question, the Examiner stated that he takes the position that the entire moiety shown in FIG. 10B of Stalling, excluding the fullerene (i.e., the C₆₀ portion), is an "aromatic group" because it includes an aromatic structure. The applicants' representative proposed a claim that recites that the carbonaceous material has attached by chemical modification at least one organic group. No specific agreement on the allowability of any particular claim was reached at the time of the interview.

Rejection of claims 5, 16, 19, 21, 28, 31, 33, 39, 42, 44, 51 and 53 under 35 U.S.C. §103(a) over Stalling et al. and JP Reference

At page 2 of the Office Action, the Examiner rejects claims 5, 16, 19, 21, 28, 31, 33, 39, 42, 44, 51 and 53 under 35 U.S.C. §103(a) over Stalling et al. (U.S. Patent No. 5,308,481) in view of newly relied upon Japanese Patent 04-346830 (Japanese '830) (Abstract only).

At page 2 of the Office Action, the Examiner acknowledges that Stalling et al. only discloses the use of fullerenes, which are carbon particles smaller than the claimed range.

U.S. Patent Application No. 09/945,340
Amendment dated August 6, 2007
Reply to Office Action dated February 8, 2007

However, the Examiner alleges that Japanese '830 teaches the use of carbon particles including the claimed particle size range having attached organic molecules and used as packing for a chromatography column (referencing only the Abstract). The Examiner further alleges that it would have been obvious to one having ordinary skill in the art at the time the invention was made to use bigger sized carbon molecules in place of the fullerenes taught by the Stalling patent, because Japanese '830 teaches that bigger carbon molecules can be used to present additional benefits with the use of the porous carbon. At page 3 of the Office Action, the Examiner further alleges that the present specification does not recite that the aromatic portion of the defined group is attached to the carbonaceous material. Therefore, according to the Examiner, the FIG. 10B shows just such an attachment, since the aromatic portion is attached to the carbonaceous material. This rejection is respectfully traversed.

Independent claim 5 is directed to a separation device comprising a mobile phase and a stationary phase, wherein the stationary phase comprises carbonaceous material having attached at least one of the specifically defined organic groups set forth in the claim, and the carbonaceous material is particles having a size of from about 1 micron to about 500 microns. Independent claim 80 is similar to claim 1 but further recites that the carbonaceous material has attached *by chemical modification* the at least one organic group. Independent claim 81 is similar to claim 80 but further recites that carbonaceous material has attached *via chemical modification* at least one organic group *covalently bonded* to the carbonaceous material. New claim 82 is similar to claim 81 but further recites that the at least one organic group has an aromatic group directly attached to the carbonaceous material. As described for example at page 8, lines 22 - 28 and elsewhere in the present specification, the attached organic group affects the adsorbent capacity and selectivity

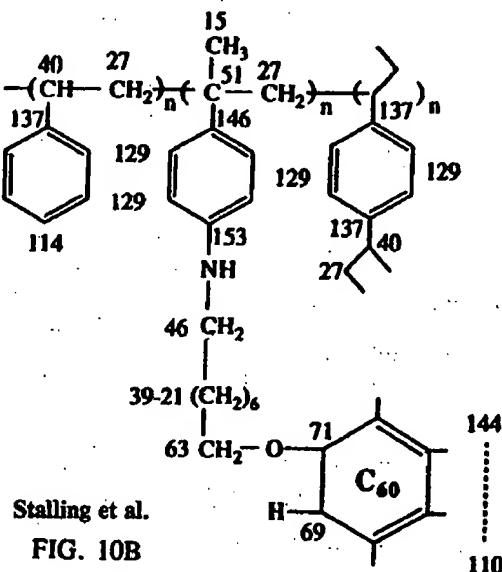
of the carbonaceous material.

As acknowledged in the Office Action, Stalling et al. shows conventional resin and silica supports being used as the stationary phases, wherein very small diameter fullerenes are attached onto the resin and silica supports using reactive groups. As shown in Figure 1A of Stalling et al., the size of the resin or silica support is shown as 1.9 microns, and the attachment of the fullerene would be significantly smaller than this resin or silica support as shown in Figure 1C. As previously shown in the record, Fullerene C₆₀ and Fullerene C₇₀ have a size of 7 - 9 Å diameter, which is significantly smaller than 1 micron. This would make sense because the fullerene would have to be significantly smaller than the size of the resin or silica support to which it is being ultimately attached to. Stalling et al. does not teach carbonaceous particles having a size of 1 to 500 microns, nor as used as a stationary phase to which is attached at least one organic group as presently recited. The secondary reference of Japanese '830 does not cure these deficiencies of the principal reference of Stalling et al.

Unlike the claimed invention, Japanese '830 describes a porous carbon fine particle that is modified with a *coating* material, such as protein A or polyethylene glycol (Abstract). The English abstract of Japanese '830 indicates that the average particle size of the carbon particles is 0.5 to 100 µm. Japanese '830 does not teach or suggest that these bigger carbon particles can be substituted for fullerenes in other applications, nor indicate what advantages might be achieved from such modifications. One of ordinary skill in the art also would understand that the particle coating disclosed in Japanese '830 is material that *physically* covers at least a portion of the carbon particles. As can be appreciated, Japanese '830 fails to teach or suggest a carbonaceous material having attached at least one organic group, and particularly not an attachment provided by

chemical modification or chemical modification providing covalent bonding between the carbonaceous material and at least one organic group. Nor is protein A or polyethylene glycol one of the organic groups listed in present claims 1, 80 and 81. As explained in the BACKGROUND OF THE INVENTION section of the present specification, prior attempts to modify surfaces of carbonaceous materials by surface modification by physical means, and, in particular, by depositing a species on the surface of the carbonaceous material have had limited utility because the deposited layer is easily removed (page 2, lines 5-8). The physically coated carbon particles described by Japanese '830 would be expected to suffer from a similar disadvantage.

Contrary to the suggestion made in the Office Action and explained in more detail by the Examiner at the interview, Figure 10B of Stalling et al., which is reproduced below, does not disclose attachment of an aromatic portion to carbonaceous material as presently claimed.



The applicants disagree that the FIG. 10B structure shown by Stalling et al. can be

properly interpreted in the manner now proposed by the Examiner. A polymeric resin support as taught by Stalling et al. would not be reasonably interpreted by persons skilled in the art as meaning "an organic group." By analogy, where a floating dock is attached to an island where the shore line meets a body of water, and one does not ordinarily refer to the land mass as being attached to the floating dock.

However, even assuming the entire moiety shown in FIG. 10B of Stalling, excluding the fullerene (i.e., the C₆₀ portion), is an "aromatic group", as proposed by the Examiner, and for sake of argument only here, that theory still fails to account for Stalling et al.'s requirement that the "carbonaceous material" in the structure are 7 - 9 Å diameter size particles. Stalling et al. specifically indicates that the fullerene serves particular purposes when attached to the porous polymer support particles (e.g., see col. 4, line 64 to col. 5, line 15; col. 5, lines 60-62). Therefore, the Examiner has not explained how fullerene could be replaced by "porous carbon fine particles" having a much larger size, i.e., carbon particles different than fullerenes. The Examiner's alleged modification of Stalling et al. in view of Japanese '830 simply would not work since one having skill in the art would have to replace fullerene having a small molecule with a large porous carbon fine particle and then somehow attach that to a polymer particle. Besides, Japanese '830 is non-analogous and is directed to different material with different sizes.

Also, the Examiner's proposed manner of interpreting FIG. 10B of Stalling et al. still fails to meet the recitations of present claim 82 reciting the at least one organic group has an aromatic group *directly attached* to said carbonaceous material. FIG. 10B of Stalling shows a: -O-(CH₂)₆-CH₂-NH- portion extending between the C₆₀ portion of the fullerene and an aromatic ring. FIG. 10B does not teach or suggest direct attachment of an aromatic group to the C₆₀

U.S. Patent Application No. 09/945,340
Amendment dated August 6, 2007
Reply to Office Action dated February 8, 2007

portion of the fullerene. Therefore, present claim 82 is even further patentably distinguished from the prior art of record.

As can be appreciated, neither Stalling et al. nor Japanese '830 teach or suggest any organic groups attached to a carbonaceous material as presently claimed, where the carbonaceous material has a particle size of from about 1 micron to about 500 microns. Therefore, the proposed combination of Stalling et al. and Japanese '830 in the Office Action does not teach or suggest any separation device as required by independent claims 1, 80, and 81, nor any of their dependent claims.

In view of at least the above reasons, this rejection should be withdrawn.

Rejection of claims 17, 29 and 40 under 35 U.S.C. §103(a) over Stalling et al. in view of Japanese '830 and further in view of Kusano et al.

At page 3 of the Office Action, the Examiner still rejects claims 17, 29, and 40 under 35 U.S.C. §103(a) over Stalling et al. and Japanese '830 in view of Kusano et al. (EP 0 300 448). At page 4 of the Office Action, the Examiner alleges that to use a different material, such as the amino acid derivative taught by Kusano et al. would have been obvious to one having ordinary skill in the art at the time the invention was made because such coating provides an 'attachment' of the organic material onto the substrate. This rejection is respectfully traversed.

As discussed above, Stalling et al. attaches a very small diameter fullerene onto a conventional resin or silica support. This is clearly different from the claimed invention, as described above, and these differences and comments apply equally here and are incorporated in their entirety by reference herein. The applicants also respectfully submit that the Examiner has misinterpreted the Stalling et al. reference with respect to the claimed invention as indicated

above. Applicants' arguments above and in the previous response are incorporated herein.

Stalling et al. does not teach or suggest any modification of fullerenes with organic groups that affect the selectivity of a chromatographic material and there is no indication that it would even be possible to make a stable modification of this type to a fullerene. Kusano et al. does not overcome the deficiencies of Stalling et al. Kusano et al. describes the use of a coating of an optically active amino acid derivative on a substrate to provide a separation medium for separating racemic mixtures. There is no teaching or suggestion in Stalling et al. or Kusano et al., either singly or combined, that the amino acid derivatives of Kusano et al. would be capable of performing the function of facilitating the attachment of fullerenes to polymer particles to form a lattice structure, or even that the amino acid derivatives of Kusano et al. could be attached to fullerenes at all. Kusano et al. does not teach any attachment of its amino acid derivatives to anything, but rather only describes coating the amino acid derivatives onto a substrate.

Also, if Stalling et al. was somehow combinable with Kusano et al., one skilled in the art would remove the fullerene and attach an amino acid onto the conventional resin or silica substrate of Stalling et al. This would clearly be different from the claimed invention since the claimed invention is using the carbonaceous material as the "substrate" to attach organic groups onto. There is no teaching or suggestion in Stalling et al. or Kusano et al., either singly or combined, that the amino acid derivatives of Kusano et al. would be capable of performing the function of facilitating the attachment of fullerenes to polymer particles to form a lattice structure, or even that the amino acid derivatives of Kusano et al. could be attached to fullerenes at all. Kusano et al. does not teach any attachment of its amino acid derivatives to anything, but rather only describes coating the amino acid derivatives onto a substrate.

Accordingly, Stalling et al., Japanese '830 and Kusano et al., either singly or combined, do not teach or suggest a separation device comprising a mobile phase and a stationary phase, wherein the stationary phase comprises carbonaceous material having attached at least one amino acid or derivatized amino acid, cyclodextrin, immobilized protein, polypeptides, or combinations thereof, as required by claims 17, 29, and 40. Therefore, this rejection should be withdrawn.

Rejection of claims 18, 20, 22 - 27, 30, 32, 34 - 38, 41, 43, 45 - 50, 52, 54 - 76 and 78 - 79 under 35 U.S.C. §103(a) over Stalling et al. in view of Japanese '830 and further in view in view of Boes et al.

At page 3 of the Office Action, the Examiner rejects claims 18, 20, 22 - 27, 30, 32, 34 - 38, 41, 43, 45 - 50, 52, 54 - 76 and 78 - 79 under 35 U.S.C. §103(a) over Stalling et al. and Japanese '830 in view of Boes et al. (U.S. Patent No. 5,807,494). At pages 4-5 of the Office Action, the Examiner alleges that Stalling et al. teaches that different attachments of the organic compounds to the fullerenes affect the chromatographic separation of the obtained separation medium and are not there merely for the formation of a lattice structure (col. 4, line 50, to col. 5, line 28). The Examiner takes the position that the secondary references, which include Boes et al. (and Kusano et al.), are cited to show the use of other organic compounds attached to the carbonaceous material. The Examiner particularly takes the position that it would have been obvious to modify Stalling et al. with the teachings of Boes et al. on the alleged grounds that Boes et al. teaches other organic groups attached to a carbonaceous material. This rejection is respectfully traversed.

The deficiencies of Stalling et al. and Japanese '830 are indicated above. As discussed above, Stalling et al. only describes reactive groups as being bonded onto fullerene to facilitate

U.S. Patent Application No. 09/945,340
Amendment dated August 6, 2007
Reply to Office Action dated February 8, 2007

the attachment of the fullerene to an inorganic polymer or siliceous particle or the attachment of fullerenes to each other. Stalling et al. does not teach or suggest carbonaceous particles having a size of about 1 micron to 500 microns. The applicants' arguments above and in the previous response are incorporated herein. Additional arguments in response to the Examiner's additional comments follow.

Stalling et al. only describes groups such as -CH₂X, -OH, -NH₂ and -COOH that are capable of facilitating the formation of a lattice structure. Boes et al., on the other hand, describes carbon black products that have attached organic groups that provide the advantage of increased water dispersability (see, for example, col. 5, lines 23 - 37 of Boes et al.). Clearly, this objective of providing increased water dispersability is directly at odds to the objective in Stalling et al. of joining particles together into a lattice. There is no teaching or suggestion in Boes et al. of using organic groups to attach carbon black particles to anything else. Therefore, a person skilled in the art would not be motivated to modify Stalling et al. with the teachings of Boes et al. Moreover, since Stalling et al. does not teach or suggest any other use for reactive groups attached to the fullerenes except for providing the fixation of fullerenes and polymer or siliceous particles and since Boes et al. contains no disclosure relevant to chromatography at all, the motivation described in the present application of affecting the adsorption properties and the selectivity of a chromatographic material by attaching organic groups is not found in either reference, taken singly or combined.

Regarding the Examiner's reference to col. 4, line 50, to col. 5, line 28, of Stalling et al., the applicants disagree with the Examiner's assertion that Stalling et al. teaches that different attachments of the organic compounds to the fullerenes affect the chromatographic separation of

U.S. Patent Application No. 09/945,340
Amendment dated August 6, 2007
Reply to Office Action dated February 8, 2007

the obtained separation medium and are not there merely for the formation of a lattice structure. It appears that the Examiner is reciting this particular passage to Stalling et al. in response to the applicants' previous arguments regarding the deficiencies of Stalling et al. However, this particular passage only indicates that certain reactive groups can be used to link the fullerenes to the polymer or silica support. At col. 4, lines 64-66, Stalling et al. indicates that the reactive groups are used to form a lattice structure. At col. 5, lines 3-8, Stalling et al. indicates only that chromatography affinity is affected by the type of polymer particle, such as a co-polymer resin particle. These polymer particles that Stalling et al. refers to, are inorganic particles. No where does Stalling et al. teach or suggest that different attachments of organic compounds to the fullerenes affect the chromatographic separation of the obtained separation medium.

One skilled in the art would have had no reason to look to Boes et al. The carbon materials are different and the uses are different from Stalling et al.

Accordingly, Stalling et al., Japanese '830, and Boes et al., either singly or combined, do not teach or suggest a separation device comprising a mobile phase and a stationary phase, wherein the stationary phase comprises carbonaceous material having attached thereto the specific groups required by claims 18, 20, 22 - 27, 30, 32, 34 - 38, 41, 43, 45 - 50, 52, 54 - 76, and 78 - 79. Therefore, this rejection should be withdrawn.

CONCLUSION

In view of the foregoing remarks, the applicants respectfully request the reconsideration of this application and the timely allowance of the pending claims.

If there are any other fees due in connection with the filing of this response, please charge

U.S. Patent Application No. 09/945,340
Amendment dated August 6, 2007
Reply to Office Action dated February 8, 2007

the fees to Deposit Account No. 03-0060. If a fee is required for an extension of time under 37 C.F.R. § 1.136 not accounted for above, such extension is requested and should also be charged to said Deposit Account.

Respectfully submitted,



Luke A. Kilyk
Reg. No. 33,251

Atty. Docket No. 96074CIP2 (3600-011-03)
KILYK & BOWERSOX, P.L.L.C.
400 Holiday Court, Suite 102
Warrenton, VA 20186
Tel.: (540) 428-1701
Fax: (540) 428-1720